

# **SERIES 4000 ENERGY METER**



## **WATT WATCHER INSTALLATION AND OPERATION MANUAL**

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## INTRODUCTION:

You now have in your possession one of the most reliable and highly accurate meters ever manufactured.

To insure proper installation and performance please take the time to read this manual before installing this meter. The installation information contained within this manual is to be used as a guide and any applicable electrical codes must take precedence over the information contained within.

### **\*\*WARNING\*\***

*We recommend that all electrical circuits that you are working on be DE-ENERGIZED prior to installation of this meter or current transformers. If this is not possible than any and all applicable OSHA Safety Rules, Union Safety Rules or any other applicable safety rules when working with energized circuits must be adhere to. A license electrician must perform this installation for all applicable warrantees to be in effect.*

The Series 4000 kit is made up of 4 components; 1 meter and 3 CTs. Solid core CTs up to 400 Amps are included in the standard kit, with larger sizes and split core CTs as an option. The line wires feeding this meter shall be protected with in-line 5 Amp fuses or a 15-Amp 3-pole circuit breaker. Most all of our current transformers have a 5 Amp at F.L. secondary output. **Never leave the black and white wires open when the meter is out of service.** There is an appreciable voltage depending on the rating of the CT and the primary load. An open CT will hum and vibrate in larger sizes.

## CHECK FOR SHIPPING DAMAGE and SHORTAGES

The Watt Watcher Meters are shipped in a protective box with the solid core CTs. Split Core CTs may be in another box. After unpacking your meter please check for obvious damage or if any components are missing. In either case promptly notify the distributor where it was purchased.

## ERRORS AND OMISSIONS:

We have taken all precautions to create a complete installation manual. NMI is not liable for any omissions or errors contained within. Please contact us if you have any questions after reading through this manual. Thank You.

**NOTE TO THE ELECTRICIAN: PLEASE LEAVE THIS MANUAL WITH THE METER WHEN LEAVING. THANK YOU!**

## **MAIN FEATURES:**

The Series 4000 is factory programmed offering one model for both 3 or 4 wire services or branch circuits. The factory has program the Amperage, and a 15-min. demand period (KW4000 only), according to the distributors purchase order.

There are six (6) kWh digits across the top section of the display, which are the kilowatt-hours accumulated. There are no resets available for kWhs, like a utility meter and there are no multipliers needed to read the energy consumed. There are three additional readings along the bottom of the display. These readings are three digits of voltage, three digits of amperage and three digits of instantaneous kilowatts. These power readings will display “HI” when the readings go to 4 digits i.e., 1000 Amps or kW.

The Series 4000 Demand Meter (Model KW4000) will scroll to Maximum Demand (pd). The demand interval is factory set at 15 minutes unless otherwise instructed. Sliding or Rolling Window is the demand method used by this meter.

The factory programs the relay to 1-KWhr per pulse, as a standard unless otherwise instructed.

There is a RS485 ModBus terminal next to the relay. This port works with our Intelligent Converter that plugs into the RS232 Com Port in your computer. NMI offers software programs. Call the factory for more information.

The voltage and the current terminals are removable. If a field calibration check is necessary the terminals simply unplug and a portable meter tester can plug into them. These terminals are a standard feature on all of our meters. Also the CTs have two extra terminals that are used when paralleling two sets of CTs. Remember Current Sensors with voltage outputs cannot be paralleled. Voltage is not additive in parallel, where current is.

There are holes in each corner of the meter for mounting the meter against a plywood board, sheet rock wall or switch boards. We don't recommend that the meters be mounted against a concrete wall. If there are any technical questions that this manual does not cover please call our technical desk at (603) 753-6321.

## THE SERIES 4000 CONNECTION TERMINALS

Terminal No.	Designation	Description
L1 – L2	Power Supply	Power Supply at 230 or 480 VAC
Relay	Pulse	Reed Relay
RS 485	ModBus Protocol	RS485 Daisy Chains to other meters
N	N	Neutral
L1	Measuring Voltage	Voltage signal from Phase L1
L2	Measuring Voltage	Voltage signal from Phase L2
L3	Measuring Voltage	Voltage signal from Phase L3
CT1 B&W	Current Transformer	Current or milli-volt signal from CT1
CT2 B&W	Current Transformer	Current or milli-volt signal from CT2
CT3 B&W	Current Transformer	Current or milli-volt signal from CT3

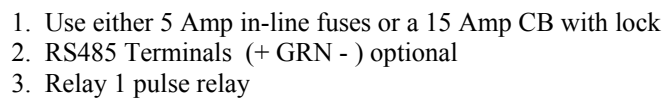
**Note:**

Color-code and size all wires according to National Electric Code.

Current Transformer wires shall be twisted to cancel noise.

Current Transformers and Line Voltage shall be phase related i.e., L1 and CT1 from the same phase the same with L2 and L3.

Three Phase 4 wire service, which also includes a Hi-leg Service.



The diagram illustrates a three-phase metering system. On the left, a delta-connected load is shown with vertices labeled A, B, and C. The load is connected to a three-phase line with lines labeled L1, L2, and L3. The metering setup includes three current transformers (CT1, CT2, CT3) on the phase lines and three potential transformers (PT1, PT2, PT3) on the neutral line. The meter's terminal strip has terminals for L1, L2, L3, CT1B, CT1W, CT2B, CT2W, CT3B, and CT3W.

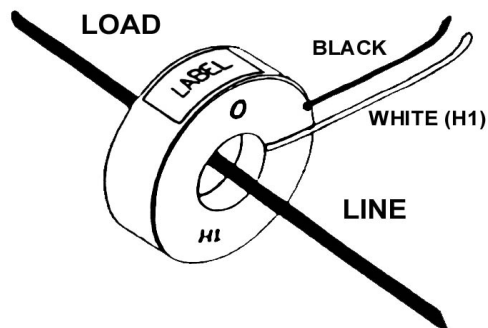
1. 5 Amp in-line fuses or 15 Amp CB with lock
2. RS485 Terminals (+ GRN - ) optional
3. Relay 1 pulse relay

## WIRING INSTRUCTIONS

1. All wiring to this meter must comply with National Electric Code or any local codes that are applicable. A grounding conductor must be installed and connected to the ground lug located under the terminal cover in the meter.
2. The voltage wires connected to the line terminals in the meter can be No. 14 gage. The load for the meter is .03 Amps. Either 5 Amp in-line fuses or a 15 Amp circuit breaker with a locking handle should protect the voltage leads.
3. The extended wires from the meter to the current transformers can be #16 gauge stranded wire up to 100' and 14 to 200' distance. The voltage and the current wires can be in the same conduit, if you twist the current wires. The CT leads must be shunted if the CT is to be installed before the meter arrives, or if the meter is taken out of service. Never leave the CT leads open on an energized circuit drawing current. Exception is the NMI-1250 split core current sensors. The secondary output of this split core is 110 mv, not current. In this case the black and white wires are capped separately if meter is not connected.
4. Form all wires neatly within the field termination area provided. An extra row of CT terminals are provided if paralleling is required. Both the voltage and the current terminals are removable if field-testing is required in the future. Please check carefully all connections before energizing meter.

### Solid Core Current Transformers

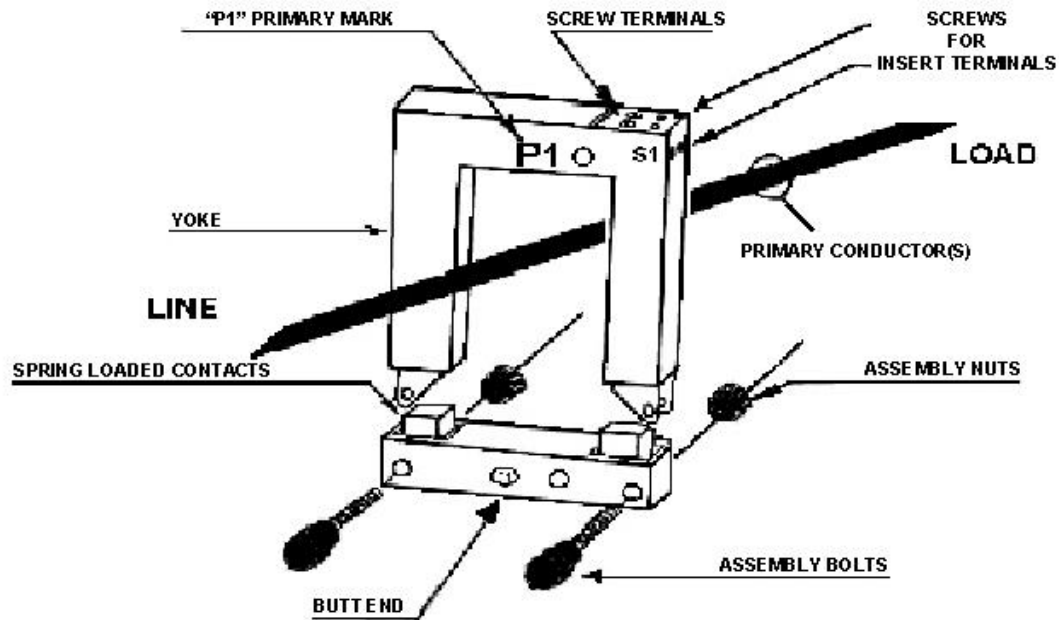
1. Solid Core CTs up to 400 Amps is supplied with this meter. The LX 400 Amp CT works in a range of 4 to 400 Amp. The solid core CTs are more accurate than the split core and are much smaller. Split Cores are available if the power cannot be turned off. The (H1) or white dot, depending on the manufacture, faces the line side of the service.



The black wire connects to the CT terminal (B) and the white wire connects to CT terminal (W).

**Note:** Shunt the black and white wires if the CT is installed and the meter has not been connected. Twist the black and white wires independently from each CT.

## Split Core Current Transformers (Model NMI-TP-Series)



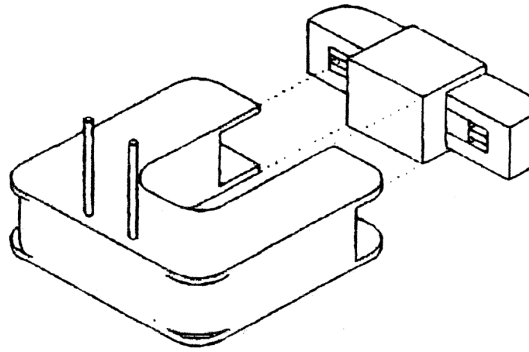
Please refer to the above drawing:

1. Remove and dispose of the packaging materials
2. To remove the end piece, unscrew the assembly nuts, push in on the end piece to relieve the pressure on the bolts. Pull the bolts out and pull the end from the main U shaped housing.
3. Position the "P1" side of the CT towards the line side of the service.
4. There are 2 screw pressure terminals labeled "S1" and "S2". Connect the white common 5 Amp wire to the "S2" terminal and black wire which is to the "S1" terminal.
5. The other two brass screws can be used for shunting out the CT with the use of a jumper, if needed. Remember to remove the jumper after connecting the CT to the meter. Do not put the CT around an energized conductor unless the CT is shunted or connected to the meter. A open CT will vibrate and hum.

**CAUTION: NMI RECOMMENDS THAT YOU TURN OFF ALL POWER BEFORE INSTALLING CTS.**



## **Split Core Current Sensor Model (NMI 1250-400)**



The secondary side of these split core transformers is 110 milli-volts at 400 Amps. You need to cap the black and white wires separately if the meter is not installed at the time the current sensor is working.

Pull hard on the bottom section to open the yoke of the sensor. Install around conductor and snap back together. Twist the black and white wires independently from each sensor. The sensor wires and the voltage wires can be installed in the same conduit. You can run up to 2000' with #16 gage wire.

### **OPERATION MODE OF THE SERIES 4000**

Front Panel of the Series K4000

1. The Display has Six kWh  $5/16^{\text{th}}$  Digits across the top and three  $3/16^{\text{th}}$  digits for Volts, Amps. and (instantaneous) kW No multipliers are needed to read the energy.
2. If Amps and kW are over 999 the display will show "HI"
3. The RATE LED will blink every time one-Kilowatt hour is consumed

## COMMON TERM USED WITH METER READINGS

**VOLTAGE:** The potential between phase and neutral or phase to phase. This can be 120 to 480 volts depending upon the model selected.

**AMPERE:** A unit of electrical current, which will flow through a resistance of 1 ohm by 1 volt.

**WATTS:** A unit of active power, which is defined as the rate at which energy is delivered to a circuit. This is the power expended when a current of one Ampere flows through a resistance of one ohm.

**kW:** A common abbreviation for 1000 watts.

**KW DEMAND:** A measurement of energy (kW) or (KVA) over a choice of a time interval in 15 or 30 minutes, which is most common. A thumb rule method is to count kWh in 15 minutes and multiply by four. Multiply by two if the demand interval is 30 minutes.

**ROLLING OR SLIDING WINDOW:** A demand interval that moves in time through a sub-interval. One example would be a 15-minute demand interval could comprise of 15 one-minute sub-intervals. The first 1-minute sub-interval will slide into the next measuring period, dropping the last sub-interval. This is the method used in this meter, and by many utility companies.

**WATT-HOUR:** A unit of electric energy that measures one watt in one hour. There are one thousand-watt hours in one-kilowatt hour.

**HERTZ:** A practical unit measuring the number of positive and negative values occurring in one second. Sixty Hz is typical in the US and fifty is used in Europe.

**VOLT-AMPERE:** A unit of volts and current that flows because of the voltage. Volt-ampere and kilowatts are the same at unity power factor. In an AC circuit with power factor other than unity the VA equal the square root of watts squared plus reactive volt-amperes squared. The greater the VA over kW is reflected by poor power factor.

**KVA:** A common abbreviation for 1000 volt-amperes.

**POWER FACTOR:** The ratio of active power (kW) to apparent power (KVA). Power Factor (PF) can be corrected by capacitors or synchronies motors.

### **THD and D (TOTAL HARMONIC DISTORTION and Distortion):**

Lets defined linear and non-linear loads. From a simple and practical point of view, a linear load is that, when supplied by a sinusoidal voltage, absorbs also a sinusoidal current. On the contrary, a non-linear load will absorb a non-sinusoidal current for the same supply voltage, although such current is habitually of periodical type. Representative examples are Static power converters, AC to DC power supplies, Discharge lamp lighting, Arc furnaces, electric welding machines, Transformers, Iron core reactors, etc.

The Distortion can be measured in two different ways, giving parameters known as “d” and “THD”. THD rate is referred to the total R.M.S. value where as d is obtained by multiplying a fundamental voltage by a series of currents with frequencies multiple of the fundamental frequency.

Expected distortion rates commonly found in power systems are 5% and below in voltage and 30% and lower in current. Higher readings do not necessarily mean a faulty facility but should be looked at for a potential problem.

**PULSE OUTPUTS:** Each pulse represents a predetermined increment of power or other quantities. Relay 1 in this meter is factory programmed for 1 pulse equals 1 kWh.

**ALARM RELAY:** Relay 2 may be field programmed to indicate high levels of energy or powers. The relay can operate in conjunction with local indicators i e, horn or light.

## **SPECIFICATIONS:**

### **Power Supply:**

Single Phase 230 or 480 VAC in applicable models

Voltage Tolerance -20% to +20%

Frequency 50 to 60 Hz.

Power 6 VA

Operating Temperature -10 to 50 degrees C

### **Measuring Circuits:**

Rated Voltage 300 V. phase to neutral and 500 V. phase to phase

Rated Current .5 Amp secondary and (110 mv.) option

Permanent Overload 1.25 %

Current Input Burden 0.75 VA

### **Accuracy:**

Voltage .05

Current .05

Energy .05

Power Factor 0.5 to unity @ +/- 1%

Measured Values between 5% and 100% of rated CT

### **Mechanical Characteristics:**

Enclosure: NEMA 1

Flame Rating: UL 94 VO

Removal Voltage and Current Terminals

### **Relays:**

Maximum Switching Voltage 200 Vdc

Maximum Switching Current 400 mA

Maximum Operations Cadence 3600 operations per hour

### **Standards:**

USL-United States UL Listed

UL 508

CNL- Canadian National Standards CUL

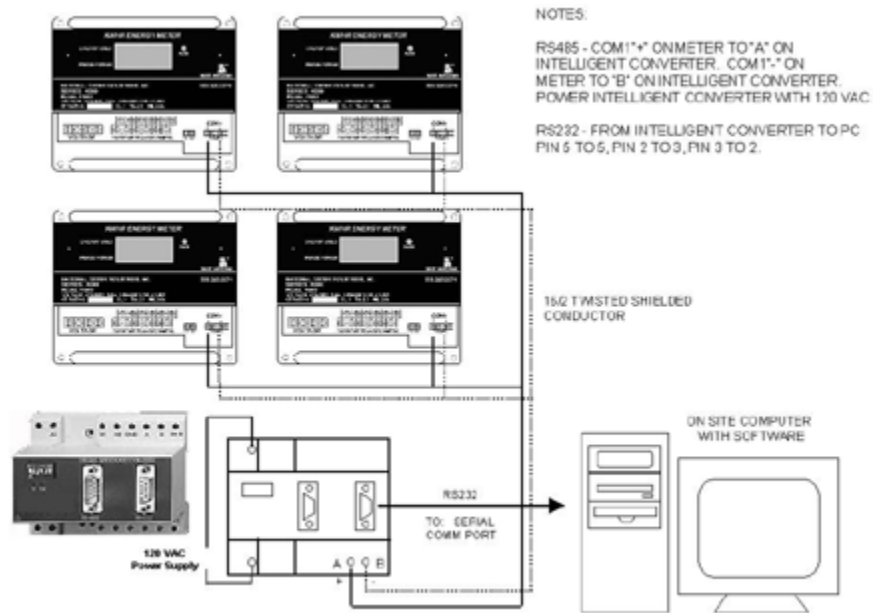
ANSI C12.16 Accuracy Compliant

FCC Class A Part 15

New York City Board of Fire Underwriters

Michigan Compliant

## COMMUNICATION NETWORK



One or more meter can be connected to a PC so you can read all the parameters at one central location. There is a terminal block marked RS485 (+ GR -) which is the connections for the 3 wire #16 shielded cable. You can connect more than one meter to a circuit, but you must assign a different identification number to each meter. This can be expanded by the use of hexadecimal coding.

## MODBUS PROTOCOL

The Series 4000 Energy Meter can communicate by means of the ModBus protocol as described below:

When the meter communicates with MoBus, it uses the RTU mode (Remote Terminal Unit). Each 8-bits byte in a message contains two 4-bits hexadecimal characters.

MoBus RTU Protocol, Default Configuration: 001 / 9600 / 8 bits / N / 1 bit  
Baud Rates: 1,200 / 2,400 / 4,800 / 96,000

The format for each byte in RTU mode is:

Code	8-bits binary, hexadecimal 0-9, A-F Two hexadecimal characters contained in each 8-bits field of the message.
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Bits per Byte	8 data bits
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Error Check Field	Cyclical Redundancy Check (CRC)
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ModBus Functions:

Function 01	Reading of the Relay State
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Function 03 or 04	Reading of n words (16 bits-2 bytes) This function permits to read all the electrical parameters. Each parameters is 32-bits long, hence two words are required to inquiry for a parameter. (4 bytes-xx xx xx xx).
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### EXAMPLE

#### Inquiry

0A	Meter peripherals number, 10 in decimal
04	Reading function
00 00	Initial address (first register)
00 0A	Number of registers to be read
7176	CRC character

<b>Answer</b>	0A 04 14 00 00 08 4D 00 00 23 28 00 00 0F A0 00 00 00 90 00 00 00 60 2E
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0A	Meter number, 10 in decimal
04	Reading function-the one used for the inquiry
14	Bytes received (20)
00 00 08 4D	V X 10 (register 00 Hex), in decimal 212.5 V
00 00 23 28	mA, in decimal 9000 mA
00 00 0F A0	W, in decimal 4000 W
00 00 00 60	PF X 100, in decimal 96 PF
CB 2E	CRC character

#### Reading digital outputs (relays)-Function 01:

Inquiry	PP0100000008CRC (PP = peripheral No.)
Answer	PP0101XXCRC

Where XX (hexadecimal byte)→translated to binary ||b7||b6||b5||b4||b3||b2||b1||b0||

bit b0 = relay 1. (1 = ON; 0 = OFF)  
bit b1.= relay 2. (1 = ON; 0 = OFF)

# **ENGINEERING SPECIFICATIONS FOR K4000 SERIES THREE PHASE KILOWATT HOUR METER**

## **1.1 GENERAL**

### **Submeter for three phase energy billing of kilowatt hours**

#### **1. Meter Technology:**

**a.** The meter shall calculate the electrical usage of individual or multiple tenant loads with the use of remote current transformers. The meter shall use microprocessor-based technology. The meter shall be capable of sampling each power waveform calculating power factor and harmonic content, to achieve accurate readings. The meter shall save the energy readings in non-volatile RAM during power outages. No batteries to be permitted in the meter.

#### **2. Meter Function:**

**a.** Calibration of the meter shall be a function of the software. The manufacturer shall use .5% resistors on all analog inputs. The meter shall be designed for lifetime accuracy using a check sum program embedded in the firmware of the meter.

**b.** The current transformer circuit on the motherboard shall contain isolating transformers, (ITF) for total isolation between the secondary side of the current transformers and the instrument measuring circuit.

**c.** The meter shall calculate energy consumption on three-phase services, 3 or 4 wire, using remote CTs to match the amperage of the circuit being monitored.

**d.** The meter shall contain a relay capable of being programmed for energy counts from 1-1000 watt hours.

**e.** The meter shall contain an RS 485 RTU ModBus port for remote reading by a PC.

**f.** The voltage and current terminals shall be removable for field calibration surveys.

#### **3. Meter Display:**

**a.** The meter shall have a LCD display. kWh readings shall be displayed in six digits. Multipliers to read energy usage shall **not** be accepted.

**b.** The screen shall also display Volts, Amps and Real Time kW phase to neutral or phase to phantom neutral if the meter is on a 3-wire network, up to 999 Amps.

**4. Accuracy and Listings:**

- a. The meter shall comply with ANSI C12.16 Electricity Metering Standards
- b. FCC Class A. Part 15 Emission
- c. UR – UL component Listed
- d. The CTs shall comply to ANSI C57.13 to .6KV
- e. UL / CUL Listed

**5. Communications:**

- a. The meter shall have an RS 485 communication port. The protocol shall be ModBus RS485 RTU. Meters to be daisy chained together and connected to a gateway, which is connected to the PC, for either on site or off site readings.
- b. The meter shall contain an energy pulse (relay) as a standard feature.
- c. **Optional:** Wireless or PLC transmitters.

**6. Enclosure:**

- a. Standard NEMA 1: Surface mount enclosure

**OPTION:**

- **NEMA 1 or 3R: Multiple Meter assemblies**